PATENT

TITLE: METHOD FOR DETECTION AND IMPROVING VISUAL ATTENTION DEFICIT IN HUMANS AND A SYSTEM FOR IMPLEMENTATION OF THIS METHOD

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Method for detection and improving visual att ntion deficit in humans and a system for implementation of this method

By Oren Lamm

ABSTRACT

Reading disorders are diagnosed and remediated in a subject by measuring and improving his ability for temporal integration of partial signals appearing in decreasing frequencies. The moving signals are displayed on a visual display consisted of lights' columns. In order to be able to perceive the stimulus in whole, the subject should follow the signals appearing on the monitor by moving his eyes in the direction and timing of the lightened columns in smooth pursuit mode. At higher frequencies, the perception of the "whole" is natural since it based on a visible persistence time range. However, when presentation frequency is decreased below that range, visual attention becomes crucial for the perceiving of the presented stimulus. Subjects suffering from visual attention deficit (e.g. Dyslexics, ADHD children, Side neglect patients) fail in perceiving the stimuli at low frequencies, at which the control subjects are still capable of adequate identification of the stimuli. A method for the treatment of visual attention deficit is suggested. The method is based on exposing a patient to a visual display, capable to generate various images suitable for use as stimuli and to run the stimuli with a required frequency in front of the patient. Following the training program, the patient's performance becomes considerably improved both on the display test and daily reading tasks.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to detection and treatment of various temporal integration disorders, affecting certain daily tasks like reading accuracy. More particularly, the present invention relates to methods and a system for estimating visual attention as opposed to visible persistence. The inventor of the present invention has found by virtue of the present invention, a considerable improvement of visual attention can be achieved. In particular, the present invention can be used for improving reading ability of dyslexic and hyperactive children.

2. Description of the Related Art

When a pattern of light falls on the retina, the image is processed within the retina by Ganglion cells, which send signals out of the eye to a relay nucleus in the thalamus of the brain. Cells of the thalamus in turn send signals to the visual cortex for further processing. There are two major types of retinal ganglion cells, which respectively contact with two divisions of cells in the relay nucleus of the thalamus: the parvocellular division and the magnocellular division.

Cells in the parvocellular division have small receptive fields and are useful for visual tasks requiring a high degree of acuity. Cells in the magnocellular division, which are about ten-times less numerous than those of the parvocellular division, have

large receptive fields and are useful for visual tasks requiring a high degree of movement detection. Cells of the magnocellular division have coarse acuity and high contrast sensitivity.

In view of the above, the vision system of a human may be divided into tw visual streams. The first stream is a magnocellular stream, which detects the movement of an object. This movement stream has a high sensitivity to a low contrast (for example, below 10%), to low luminance, to movement, and has low resolution. The second steam is a parvocellular stream, which detects the color, shape, and texture of patterns. This second or acuity steam has low contrast sensitivity and high resolution. The acuity stream is most sensitive to contrasts above about 10%. The parvocellular and magnocellular cells, either alone or in combination, provide the information used by many different visual cortical pathways (or "streams") which are specialized at performing different perceptual tasks. One such specialized pathway is a visual cortical area called Medial Temporal, or "MT," which is instrumental in the analysis of direction of motion. Most of the signals that drive neurons in the MT area derive from neurons in layer 4b of the primary visual cortex, which neurons in turn are primarily supplied by input from the magnocellular cells. (In primates, the primary visual cortex is the only cortical area that receives signals from the retina via neurons in the thalamic relay nucleus.) Direction selectivity is a fundamental characteristic of the magnocellular neurons and is mediated by cells in both layer 4b in the striate cortex and in the MT cortex. Certain aspects of magnocellular networks, such as direction discrimination and detecting of brief patterns, are still developing in all children with the age of 5 to 9 year, as compared to normal adults. Some researches suggest that disorders of reading acquisition in children are related to magnocellular deficit or developmental impediment. This hypothesis is supported to some extent by findings that indicate that dyslexics have anomalies in their magnocellular networks, demonstrated by (1) higher contrast thresholds to detect brief patterns, (2) an impaired ability to discriminate both the direction and the velocity of moving patterns, and (3) unstable binocular control and depth localization when compared to normal individuals of the same age. There exists substantial evidence that dyslexics have a disordered posterior parietal cortex and corpus callosum, having immature inhibitory networks that severely limit a child's ability to discriminate direction of movement and ability to read. However it should be kept in mind that most of the mentioned evidences were criticized on several grounds by other dyslexia researchers.

Reading is the most important skill that is learned in the first and second grades. Yet there are no standardized ways to evaluate or to teach reading. A natural assumption is that reading relies on the higher resolution pattern system evaluated by measuring an observer's visual acuity and color discrimination ability. It is generally believed that movement discrimination is involved in reading solely as a means of directing eye movements, coordinating each saccade so that letter recognition can be conveyed by the portion of the vision system, which has a higher resolution. It is intriguing that difference between children with reading problems (e.g., those who are dyslexic) and children with normal reading ability were revealed only by tests of the cortical movement system. On the other hand, tests implementing the pattern system, such as visual acuity using long duration patterns, revealed no differences between children with normal reading and children with reading problems. However, a recent study questions whether dyslexic children show a temporal processing deficit, and another

study concludes that the contrast sensitivity functions (CSFs) of dyslexic children are unrelated to their reading ability.

However the main claim of those researchers holding the view that dyslexi is related to magnocellular deficit is that dyslexics have longer than normal visible persistence while reading du to the lack of magnocellular inhibitory effect on parvocellular activation. According to this view, the saccadic eye movements between fixations activate, in normal readers, the magnocellular system which, in turn, inhibits the parvocellular activation initiated by the processing of the text seen at the former fixation.

Due to magnocellular deficit in dyslexics, this inhibitory process is unreliable causing a masking effect were visual information gained in a former fixation masks the information gathered in the next or vice versa. Thus the longer than normal persistence in dyslexics according to this view is due to a deficit in the system that is supposed to terminate it.

If this was true then watching a text presented on a special display that gives an advantage to longer than normal visible persistence duration could be used to improve dyslexics reading.

Experiments conducted by the inventor with such a display clearly indicated that dyslexics exhibit inferior rather then superior reading of display texts compared to normal readers. It was also verified that dyslexics were inferior comparing to the control group in recognition of any stimuli presented by this display. Further investigations indicate that dyslexics' difficulties are related to visual attention deficit that impede temporal integration of the visual partial signals when those presented at low frequencies.

BRIEF SUMMARY OF THE INVENTION

In view of the foregoing drawbacks of the existing methods, known in the art, one of the objectives of the present invention is to provide methods and apparatus for diagnosing and remediating reading disorders by respectively measuring and improving visual attention. This is done by exposing the patients to slow smooth pursuit tracking of fragmented stimuli.

Dyslexic children who were treated by the method of the present invention significantly decreased their error reading rate after six to eight training hours and became significantly more efficient readers than children treated by other methods.

According to one aspect of the invention, a sequence of alphanumeric stimuli is displayed on a special display, capable to present the stimuli in a running mode. An example of a suitable display is the graphic display system described in the US patent 4162493. In this system, the lights of an array are arranged in dot matrix and, when illuminated, are capable to produce the illusion of a moving sign displaying letters, words, numbers, texts etc. This system has been initially designed for advertising and employs the phenomenon of beta apparent motion to enable a moving image of a high resolution to be produced with the use of a small proportion for example 1/8, of the number of individual lights that would normally be considered necessary.

The lights are preferably arranged in consecutive columns being illuminated in turn in the direction of apparent movement of the image.

The display system enables control of time gapes between stimulus fragments with 1 millisecond precision. It has been empirically revealed that in a large subgroup of poor readers, being exposed to this display a visual attention deficit can be reliably established, which is closely related to their reading difficulties. It has been also found, that this deficit can be eliminated by further exposing the poor readers to the

display according to the method of the present invention, which is described in more details later.

The principle of the present method will be referred-to further as smooth pursuit tracking of stimuli fragments at slow tracking velocity. Smooth pursuit tracking as opposed to saccadic scanning implies in this context means that stimuli should be presented such that the visual illusion could be generated only if eye movements along the display are continuous and bear no fixations. Slow velocities in this context mean time intervals (gaps) between lighted columns that are longer than those, which are within the time range of visible persistence limit.

The present invention comprises the following main steps, described below in a form of example.

Step 1. Preliminary training of a patient (child or adult).

This step is carried out by exposing a patient to a group of running stimuli consisting of 10-20 alphanumeric signs and/or words. The stimuli are displayed by the above mentioned graphic display system in a running mode with a velocity matching the visible persistence limit of a normal person, who does not suffer from visual attention deficit. In practice the required velocity at this step is established by setting a time gap of 80 milliseconds between adjacent stimuli. Usually, patients identify the displayed stimuli during the first or second run of the preliminary training.

Step 2. Diagnostics.

During this step the patient who passed the first step is exposed to several groups of stimuli, consisting of randomly presented words. The groups consist of different words and they are not identical. The groups are displayed at, say, three different velocities, which correspond to the time gaps of 80, 144 and 180 milliseconds. During each run a performance of the patient is recorded in terms of amount of words correctly recognized by him from each group and at each velocity. On the basis of these results, the patient is attributed either to a person with normal reading ability, or to a person who suffers from visual attention deficit.

Step 3. Treatment.

During this step the patient is exposed to those groups of stimuli, which he failed to recognize at the previous step at a certain velocity (failure velocity), but however successfully recognized them at the other (higher) velocity (successful velocity). The stimuli are displayed at this step at an intermediate velocity, which lies between the failure velocity and the successful velocity. The performance at the intermediate velocity is monitored and the intermediate velocity is varied according to the achieved results.

The invention refers also to a system, which enables to carry out the above method. The system comprises visual display connected to a computer, e.g. a PC. The display employed in the system is capable to generate visually recognizable stimuli and to present them in a running mode. The PC is provided with a suitable software, which enables to control the display, to generate different stimuli, to vary the parameters of their display in running mode, e.g. time gap between the stimuli, size of stimuli, etc. The PC is also capable to accumulate, to store, to process the achieved results and to present them statistically, graphically or in any other desirable way, suitable for analysis and monitoring of the results.

BRIEF DESCRIPTION OF THE DRAWINGS

For better understanding of the invention and the way of how it my be carried out in practice, the invention will be now described with reference to the ccompanying drawings in which:

Fig. 1 pres nts graphically how the failure in recognizing of stimuli during the treatment depends on the time gap. The graph refers to a group of control patients and to a group of those who suffer from visual attention deficit.

Figs.2-4 show various groups of stimuli, which are presented during carrying out the method of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The method of the invention has been devised on the basis of empirical work carried out by the Inventor.

The first investigation of the above-mentioned graphic display system for treatment of visual attention deficit was intended to examine the hypothesis that subjects of different dyslexia subtypes would perform differently when they are requested to recognize stimuli presented in a running mode by the above-mentioned display. It was hypothesized that dyslexics suffering longer than normal visible persistence would better recognize simple alphanumeric stimuli than normal readers and other dyslexics given that stimuli are presented at low velocities preventing temporal integration on basis of normal visible persistence. However it was found that visual-motor dyslexics were significantly inferior to surface dyslexics and normal readers in identifying the presented stimuli running at low velocities. No differences were found between other dyslexics and control patients.

It was also found that training in reading via the display improves the visual -motor dyslexics' performance both in identification of stimuli at low velocities and text reading - especially with respect to reading error rate. However the three experiments performed included a small number of subjects (at most 12 subjects in each experimental group) and did not allow a reliable estimation of reading impaired rate and the rate of such subjects that may benefit from a rehabilitation program intended to improve their attentive visual scanning.

Based on the knowledge and data gained from the above-mentioned experiments new large-scale trials were performed. These trials will be described in details since they are the main factual basis for my invention.

<u>Experiment 1.</u>

This experiment was intended to examine the distribution of poor readers, age matched control patients and reading age control patients according to their identification performance in different presentation velocities.

Method:

Subjects: 866 subjects (age range 8 to 55) took part in this experiment. All subjects were native Hebrew language speakers that were educated in Israel with normal or corrected visual acuity.

The vocal reading fluency (reading speed and error rate) of all subjects was estimated by normative to the age/education level texts. Poor readers sample included only subjects that were 1.5 SD or below normal level on one measure and 1.0 SD or below that on the other. The control sample included only subjects that were at least 0.5 SD above the normal level on both measures.

Table 1 presents the distribution of subjects in both samples according to their age and gender.

Table 1
Subjects' distribution according to age and gender

C ntrol group

	Sums	Females	Males	Age Group
	188	71	117	12 - 8
	168	64	104	17 - 13
	154	73	81	25 - 18
	41	15	26	55 - 26
Sums	551	223	328	

Poor readers

	136	38	98	12 - 8
	111	24	87	17 - 13
	68	17	51	25 - 18
	-----	-----	----	55 - 25
Sums	315	79	236	

Procedure

Subjects' competence in identifying fragmented alphanumeric symbols and words in different time gaps between fragments were tested by exposing the subjects to the stimuli running over a graphic display similar to that described in Ross et al. 1976 invention and according to the following procedure:

a) Subjects were instructed to follow smoothly the lighted columns at the pace of the light traveling from one column to the next. Each subject was subjected to 12 to 20 training trails at fixed velocity. The time gap, corresponding to this running velocity was well within the time range of visible persistence (32 milliseconds gap between successive presentations of a fragment on adjacent columns).

In order to pass the test phase it was required to demonstrate 90% correct identifications within 3 presentation cycles of each stimulus.

All subjects completed the training phase successfully within 15 minutes.

After this step the further step has been carried out.

b) Each subject was exposed to stimuli presented at 4 different time gaps. Th term time gap in this context means the time interval (milliseconds) between the lighting of two adjacent columns, which run over display. Proper tracking velocity is determined by this time gap. The stimuli were present d as 4 gr ups, having different list of words.. Each list included eighteen words, consisting of 3 to 5 letters. All words were th most common in written Hebrew for school childr n

The basic time gaps for the different lists were 58, 116, 232 and 464 milliseconds. Each list was displayed at one of the above time gaps at random for each subject. Single presentation order was used, i.e. from the shortest time gap to the longest. Subjects' performance was recorded. When the rate of correct responses for a given list in a given time gap did not exceed 28%, the time gap was shortened in half of the distance between the failure time gap and the preceding one (e.g. failure in 232 milliseconds time gap and above criterion performance in 116 milliseconds led to a test with 174 milliseconds time gape).

A list of 18 stimuli (consisted of words taken from the original four lists) was used for the test in the intermediate time gap. This procedure was repeated if failure was recorded at the intermediate gap, till the above criterion level performance (28% of correct identifications) was reached.

Performance higher than the criterion level at the intermediate gap led to the increase of the time gap in half the distance between the intermediate gap and the preceding one were failure was inspected. This procedure was repeated till the first below criterion performance was recorded again. Distribution of failure time gaps in both samples (controls of age group 26 - 55 are not included) is presented in Figure 1.

It is evident from Figure 1 that dyslexics fail at relatively shorter time gaps than the patients of control group.

Table 2 presents the average number of correct responses in the longest time gap where the patients's performance was above the criterion level and the average correct responses in the failure time gap in both samples.

Table 2

	Average correct responses in failure time gap	Average correct responses (last success)
control(N=510)	X = 2.78 SD = 0.89	X = 16.70 SD = 1.64
Dyslexics (N=315)	X = 2.38 SD = 0.66	X= 15.8 SD = 2.17

Table 2 indicates that the transition from success to failure is quite sharp and that within 20 to 30 ms time gap difference, performance may drop from 80 to 100 % correct responses to less than 20% correct responses.

Experiment 2.

This experiment was intended to examine the effect of the present treatment method for improvement of attentive scanning upon reading performance of dyslexics.

Method:

Sixty male dyslexics of the former experiment that failed in time gaps of 126 to 184 milliseconds were the subjects of this experiment. This time gap range was chosen

since within it as much as 38% of dyslexics failed while only 5% of controls did not d monstrate from 90 to 100 percent corr ct responses.
The 60 subjects were sampled in triplets according to age and time gap failure. This enabled the division of the sample to three groups.
One group used as the xperim ntally treated group (treatment group). The second was given an alternative treatment ('placebo') and the third group did not get any treatment (no-treatment group).

<u>The treatment group</u>

Each of the 20 subjects of this group was engaged with eight one-hour treatment sessions. In the first session the subjects were exposed to words and texts presented at time gaps of their last success in experiment 1. Gaining 90% or more correct responses with/without help led to the increase of time gap in quarter (e.g. subject that performed successfully in time gap of 117 milliseconds were presented with stimuli at 146 milliseconds). The same stimuli were presented at the increased time gap. If performance level did not dropped, a new set of stimuli was presented at the same time gap. Time gap was increased again if performance level for the new set was within criterion level. If, during the next 15 minutes of testing, the performance was still below the criterion level the time gap was decreased in half of the difference between the last success and the testing gaps. This process continued until the end of the treatment sessions.

<u>Placebo group</u>

The 20 subjects of this group were given 8 thirty minutes treatment sessions of regular text reading. Each subject was presented with texts and words submitted to his yoked subject in the treatment group. The shorter treatment sessions in this group made more adequate the actual exposure time to texts as compared to the treatment group.

<u>No treatment group</u>

The subjects of this group were given the display test and the regular text reading tests but were not exposed to any treatment in between by the experimenter.
On average, the time between initial and final testing in all groups was two and a half months.

Table 4 presents the vocal reading speed and error reading rat for standardized regular text before and after treatment.

Table 4

	Reading speed (words/min)		Error rate (%)	
	Before	After	Before	After
Group				
Treatment	X= 74.6 SD = 26.4	X = 87.3 SD = 19.9	X = 11.20 SD = 5.70	X = 4.10 SD = 2.80
Placebo	X = 77.9 SD = 27.2	X = 83.3 SD = 28.6	X = 10.40 SD = 5.10	X = 8.80 SD= 5.2
No treatment	X = 72.8 SD = 23.7	X = 74.5 SD = 25.0	X = 13.2 SD= 6.6	X = 12.9 SD = 6.2

Since the texts given were standardized fluency tests, the subjects' performance could be evaluated according to their standard scores. Table 5 presents these data.

Table 5

Error rate		Reading speed		
Before	After	Before	After	
- 0.69 0.74	- 2.58 1.12	- 1.43 0.48	- 1.83 0.56	Treatment
- 2.06 1.64	- 2.32 1.75	- 1.60 0.72	- 1.69 0.63	Placebo
- 3.11 6.2	- 3.22 6.6	- 1.46 25.0	- 1.90 23.7	No treatment

These data show the advantage of the display treatment over spontaneous improvement and routine reading training in the subjects. The main effect appears in reading error rate decrease. In order to evaluate the improvement consistency within subjects of the experiments, the difference of the fluency measures were calculated for

each subject in each group. In 19 out of 20 subjects of the treatment group, a decrease of rror rate t was recorded as compared to 8 and 10 cases in the other groups. Table 6 presents th standard scores of the fluency measures for a novel text read only after the end of the treatment sessions.

Table 6

Error Rate	Reading speed	
0.5 0.62	- 1.05 0.86	Treatment
1.94 1.43	- 1.23 1.0	Placebo
– 2.08 1.03	- 1.42 0.93	No treatment

These data complies with the previous data as to the treatment effect on the reading error rate.

Clinical observations and post hoc analyses

Since most of the reading disabled participated in the above mentioned experiments were assessed by a cognitive battery intended for diagnosis of learning disabilities (Gordon et. al), it was of interest to examine weather their failure in the display test correlates with the performance on other cognitive tests.

In order to perform the correlations' inquiry, 116 files of subjects that failed in time gaps of 126 to 172 milliseconds were chosen (in that gap range only 2.9% of controls failed). The files of 116 matched reading disabled that performed normally on the display test were picked up too. Table 7 presents the distribution of the experimental group subjects according to age and gender.

Table 7

57	13	44	12 – 8
34	8	26	17 – 13
25	6	19	25 – 18
116	27	89	Totals

The performance of both groups on 27 different c gnitive measures was examined. Four main tests were f und to correlate with the display failure:

1. Point location in two-dimensional space (Gordon).
The average standard score of those failed in the display test was far below normal score (X= -1.6, SD = 1.19).
The matched reading disabled that performed normally on the display test was within the normal level (X= 0.56, SD = 1.38)

2. Digit – symbol test (Wecsler).
The average standard score of those failed in the display test was X= 7.64, SD= 2.26.
The average standard score of matched reading disabled was X= 8.40, SD= 2.68).

2. Digit –Logograph test (Lamm).
The average standard score of those failed in the display test was X = 7.16, SD = 2.33.
The matched reading disabled standard score was X= 10.34, SD = 3.06.

3. Specific graphic characteristics in writing to standard dictation (Lamm).
No standard scores are available for the evaluation of subjects' handwriting.
However it was clear that letters/words spacing and keeping parallel lines were much poorer in those subjects that failed in the display test (see examples).

The writing sheets of all subjects were evaluated by three independent observers, which were required to score each according to several criteria. It was found that the best differentiating criterion was letter and word spacing. Subjects that failed on the display test got average score of 3.9 (SD= 2.6) on an 1 to 9 scale. Other reading disabled got 7.2 (2.0). Comparable normal readers received an average score of 8.4 (1.8).
Some other tests differentiate the groups in the reverse direction. That is, the display failures were performed normally on these tests while the other reading disabled showed significantly inferior performance to norm level. Among these tests were free recall Word Dichotic Listening (Gordon) and the digit span (Wecsler) tests.

Background differences.

The main background difference between the two groups of poor readers are related to diagnosis of ADHD. In the display failures, 46 subjects were recommended to be treated by stimulants following medical assessment. Other 28 were labeled as ADHD by psychologists or other professionals in the fields of child development. The background data from other disabled readers indicate that only 7 subjects were actually recommended to be treated by stimulants and other 19 were labeled as ADHD following psychological or other developmental assessment.
Thus it seems that the graphic display is most useful treatment device in cases of Dyslexia and ADHD comorbidity.

On the basis of the above-mentioned xperiments the present method has been developed and can be used in clinical settings.

It is disclosed below how the present method can be used for treatment of school children and adults.

1. Training step.
Subjects are presented with 15 initial training alphanumeric stimuli presented each in a time gap of 80 milliseconds. These include all letter lines and angles used in the Hebrew alphabet. An example of the stimuli is shown in Fig.2a. Each stimulus is presented up to three times and subjects are instructed to name the presented stimulus. At this time gap all subjects identify all stimuli on the first to second presentation. Following initial training, 54 words are presented in random order and in one out of three time gaps, which are 80, 144 and 180 milliseconds. The subjects' task is to name the word or it's letters.

2. Test step.
The subject is exposed to stimuli divided into groups as listed in Figs. 2b-4. Performance is evaluated on the basis of correct identifications for each velocity / time gap. Prior data clearly indicate that normal readers can identify 16 to 18 stimuli out of the 18 presented in each time gap. Most poor readers fail on the 180 milliseconds gap and gain 0 to 5 correct responses. In severe cases this result is also recorded in the intermediate gap. Subjects that gain 6 to 15 correct responses for any of these time gaps are scarce.
Thus, in most cases the results of this test are a clear cut and detect the appropriate candidates for subsequent treatment.
The same procedure is also available for pre-school children but, instead of alphanumeric signs, namable object pictures are presented.

3. Treatment step.
The same stimuli as in the previous step are used. The treatment step is based on a systematic time gaps selection according to subjects' former performance. Subjects that failed on the test in 180 milliseconds gap but performed reasonably on 144 milliseconds gap (16 to 18 correct responses) are presented with letters, words and sentences in intermediate gap (162 milliseconds. for this example). Successful performance (90% correct) leads to the enlargement of the time gap to intermediate time between 162 to 180 milliseconds. If, on the other hand the subject fails on 162 milliseconds gap he gets the help of the experimenter for 15 minutes in identifying the presented stimuli. If the subject himself within this time limit does not reach the identification, the time gap is shortened in half the gap between 162 to 144 milliseconds and the procedure is continued along the same lines. Improvement within 15 minutes lead to the use of new stimuli, never presented before, at the same time gap. If adequate performance for that list is gained, the time gap is increased in half the time distance between 162 to 180 milliseconds. If 90% correct responses are not recorded without assistance, the same list is used in a time gap, which is shorter in quarter of the distance between 144 and 162 milliseconds, i.e. 58 milliseconds. The enlargement of time gap in the treatment sessions always follows after successful reading of a new list never seen before by the subject. The same list is used in the initial presentation at the enlarged gap. Shorting of the time gaps is always combined with the use of the last list presented at the larger time gap.

The training sessions are continued until the performance level of 90% is reached for 240 milliseconds gap or until the end of the eight one-hour sessions. Most subjects reach this criterion level within 5 to 8 sessions. Others reach 90% correct responses rate for gaps, which are between 200 to 235 milliseconds. Only few subjects (11%) do not reach that level following eight sessions' training.

The same procedure can be also exploited for preschool children while specific object pictures instead of words are exposed on the visual display.

The present method can be implemented in any system, which comprises a graphic display, capable to generate stimuli and to present them in a running mode and a control means, e.g. a PC, suitable for varying the parameters of the graphic display, e.g. time gaps, sequence of display, etc. and at the same time suitable for recording the performance and its statistical evaluation.

CLAIMS:

1. A method for detection and improving of visual attention deficit in humans, said method comprising:
   a) Generating of at least one group of visually recognizable stimuli
   b) Presenting the stimuli in a running mode, defined by a time gap between adjacent stimuli
   c) Exposing a patient to at least one group of stimuli
   d) Determining the ability of the patient to recognize the stimuli within the group and
   e) Varying the time gap in accordance with the ability of the patient to recognize the stimuli.